

# Life through the Lens: A Qualitative Investigation of Human Behaviour with an Urban Photography Service



Figure 1. Photographs taken and annotated by users of a public kiosk capture diverse behaviour. From left: a) a student posing and greeting in a foreign language, b) users demonstrating ill-behaviour, c) teenagers self-narrating their activities for the day, and d) anonymous, controversial opinion being shared through the photograph.

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## ABSTRACT

The proliferation of computation in our everyday environment enables new types of interaction and communication devices. Understanding the dialogue between users and such technology is crucial to the success of future urban computing deployments. We investigate human behaviour in public spaces using a public photography service deployed on interactive public displays in an urban city. Through the analysis of user-generated snapshots we show that the service was rapidly appropriated outside its intended purpose, resulting in use that differs substantially from those previously documented in photography literature. We reflect on the reasons why the service was appropriated in this way and explore the evolution of photography in urban contexts. Ultimately, our findings help ground our understanding of human behaviour in urban spaces and thus contribute to the design of

future Ubicomp deployments.

## Categories and Subject Descriptors

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## Keywords

Public spaces, public displays, human behaviour, photography, field trial

## 1. INTRODUCTION

This paper presents a qualitative investigation into human behaviour with public camera devices in urban spaces through the lens of user-generated photography (See Figure 1). The photographs result from a service on large public interactive displays that allows people to take a snapshot using a web camera, add a caption to the photo and upload it to public online gallery. We study and discuss the photographs to explore human conduct with such cameras, mounted as a part of the urban city itself. Specifically, our contributions are:

- We present and analyse findings from a longitudinal deployment of a public display photography service
- We identify psychological and sociological motives that cause people to engage with public displays using such a photography service

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- We propose digital mirrors, public photography services that differ substantially from other camera media, as a conceptual milestone in the evolution of photography

One of the great aspects of HCI conferences has been their concern to explore the user and not only the computer. Central to this view is the concept of human behaviour in the locations where computational resources are located. In the urban city, people do not just stand still in a place but put effort into engaging with, and reacting to, the places they inhabit and to the gadgets and computers they use. The affordances of these resources are made relevant only through the behaviour that they elicit from their users. Thus, the success of a technology should not be assessed solely on its goals set by designers or researchers, but we should look into its relevancy to the space through what it affords to the inhabitants of the space.

Interactive public displays are one proliferating urban computing tool that has been lately gaining interest among researchers [11,14]. Web cameras and user generated photography in general on public displays has been shown as appealing to their users [7,8,12]. So, what kind of behaviour is afforded and fostered by cameras on public displays? People go to a public space and look at messages on public displays, adverts for example. However, the possibilities offered by the camera itself, mounted in the display and “looking at the users”, for engaging with the environment and other users have so far been limited. In this study we explore these emerging patterns in an authentic urban city environment. We look through the lens of the camera devices in a setting that is fully unsupervised, uncontrolled and populated with authentic, uncoached users. To the best of our knowledge, a similar, highly public photo service covering several urban locations does not exist anywhere else in the world, making the analysis presented here unique.

## 2. RELATED WORK

### 2.1 Digital Photography

Low cost digital cameras and especially the proliferation of camera phones have made digital photography available for the masses and created new ways of sharing and utilizing photographs in our everyday lives. In their book on evolution of photography Sarvas & Fröhlich [18] note that despite this strong technology push, the profound reasons behind photography itself have not remarkably changed, but rather their balance has shifted over time. Whereas before the current digital era of photography, pictures were mostly printed and archived in physical photo albums, today digital photos have a much more short-lived and situated nature. For example mobile phone cameras are increasingly being used for work-related tasks, such as documenting ongoing projects in real time or supporting discussions about them [9]. At the same time, personal reflection and identity construction have remained the key psychological motivators for photography in general, i.e. pictures are still often used to showcase an image of the self [23].

An important feature of digital cameras is the ability to instantly view the captured snapshots. Van House [23] and Kindberg *et al.* [9,10] studied the spatial and temporal aspects of digital photography and found the role of in-situ sharing and displaying of photographs to have a very important role, making the moment of taking the snapshot a social end in itself. Such face-to-face sharing of photography and the entire social experience around it is seen much preferable to using remote sharing methods, such as dedicated software or web based tools [3].

Besides observing the occurring use practices of photographs, the visual power of digital photos has been trialled with more intrusive and novel setups as well. Harper & Taylor [5] deployed a sophisticated mobile phone prototype, the Glancephone, designed for requesting photographs of other users in an attempt to probe whether it is appropriate to call and thus interrupt them. The goal of interruption management was quickly put aside to appropriate the service for telling stories and to highlight the users’ current activities. In other words, photographs were found as a powerful tool for real time broadcasting and advertising oneself.

Another technology probe introduced photos from personal social networking service accounts to the dining table, shedding light into the social dynamics around photo mementos during shared eating [15]. The autobiographical photographs were found to have a strong impact in supporting the assumption of roles in the table and providing opportunities to express interests and attitudes. Further, the photograph display made it easier for those present to offer compliments and express affection.

Much research has focused on sharing, utilizing and capturing digital photographs with mobile phones or dedicated prototypes, and more often than not this research originates from results from a narrow set of users and their motifs for the camera use. In such setups the camera operator, i.e. the photographer, always has an impact on the behaviour of the subjects [20] and is in control of the camera device, overall situation and the ultimate use of the photographs.

In our work we focus on the use of large form factor, immovable and completely public camera apparatus that are not operated by a human photographer. The public cameras create a public online gallery of the resulting snapshots and are used by a wide range of people in urban settings. Next, we expand on urban computing and public display literature to better frame our study.

### 2.2 Public Displays

Much research on networked displays has focused on the provision of services to the general public, including news, localized event calendars, feedback channels, entertainment, etc. [6,13,16]. Photography services have been found to have a great appeal in this context as well. Taylor & Cheverst reported on an impressive deployment of a public display as a tool to document village life using user-submitted photographs [22]. Users of the Wray Photo Display adopted it as a means to promote local awareness, document local history and familiarize tourists and newcomers to the town. The key takeaway of their study is that a well-designed public display utilizing topical and spatially relevant photography can be effectively used to support many different communities. Peltonen *et al.* presented CityWall, a large interactive multi-touch screen that displayed user-submitted photos from local events [17]. The installation ended up acting as a “stage”, and together with community-submitted photographs it changed the surroundings into a mingling area where people playfully interacted with the installation and each other in ways that normally would not happen in such a space.

Public displays can be utilized for sparking curiosity in different ways. For example, previous research has discussed seeing oneself on a display, the so-called “mirror metaphor”, as an efficient way to encourage users to interact with a public display and become active participants [7,20]. This is one example of means to combat display blindness, a fundamental problem with public displays, which refers to the lack of interest and attention from general public. Another effective mechanism to combat display blindness, the honey-pot effect coined by Brignull &

Rogers [1], refers to the persuasive effect of crowds. When people gather around and pay attention to a display, it raises curiosity and lures others to use or at least to notice the display. However, the opposite may happen as well: people block the display, effectively preventing it from being used by others [13].

A public display's usability and effect on its environment change as the setup shifts from a single to multiple users. For example, with multiple users the social activity does not always occur through the display per se, but rather around the display [11]. Thus, social roles have a great impact on the use of display. In groups, people also behave more openly. For instance, Hosio *et al.* reported on a photography application on public displays that allowed taking a photograph with an embedded web camera and emailing it to any email address [8]. They observed groups of up to 20 people joyously posing in front of the displays for long periods of time, taking snapshot after snapshot in attempt to capture the perfect moment to share. Finally, and perhaps most related to our work, Memarovic *et al.* recently presented an excellent study about Moment Machine [12]. Moment machine is an urban photography service that allows users to contribute photos from the screens. The photos are transferred online, but can also be browsed in-situ on the screens. The analysis revealed a palette of reasons behind snapshots as well as findings on how the service supports place-based communities.

The context of our study is rather unique. Our results are obtained from a longitudinal (6 months) deployment in urban settings, where the displays offering our system were available for anyone in a true 24/7 fashion and without the presence of researchers. There was no social pressure for the users to “do as they were told”, creating strong grounds for natural behaviour around the offered system to occur. We analyse the results through a highly human-centric lens, focusing on thematic analysis of the snapshots. Further, we discuss the results especially in the context of photography and the development of photography.

### 3. FIELD TRIAL

#### 3.1 Service Design

The service was initially not designed as “just” a photo application, but it was created to allow users to give feedback to the local authorities and to allow further discussions about municipal issues in Facebook. The first series of case studies of the service were conducted in controlled semi-public environments. The deployments were regarded highly successful in collecting feedback from and reaching out to otherwise unreachable residents. The findings from these case studies are reported in more detail in our earlier work [7]. Due to space considerations, we will not include the entire original design rationale, but the key requirements were: 1) exploit public displays' attractiveness, 2) design for playfulness, and 3) extend the interaction by leveraging social media.

#### 3.2 The Service Features

The service allows users to take a snapshot using a camera embedded in a large public display, add a caption, and submit the photographs to the authorities (Figure 2). The submitted photos cannot be viewed on the public display itself.

The service operates in four phases. Users can browse between the phases by touching large buttons in the lower part of the screen. First, users are shown general usage instructions and info on how the service functions. The second screen presents examples on what kind of photos the service produces. Unlike with Moment Machine [12], users cannot see real photos taken by other users in situ. The photos here were created by researchers

and city authorities when designing the service. Then, users can take a snapshot (after a 10 second countdown) using a camera embedded in the top of the display. This photo can be retaken as many times as necessary. Finally, the caption, or a thought, is typed into a speech bubble or protest sign embedded in the picture using a virtual on-screen keyboard. When users click the submit button, the picture and caption is submitted and added to a public photo album in a dedicated Facebook page. The page is then accessed via a dedicated top-level domain, moderated and frequented by the City officials, and used for further civic discussions and responding to the given feedback.



Figure 2. The four phases of the photography service. From top-left: instructions and description; example photos with captions; live webcam stream and camera button with countdown for taking snapshots; virtual keyboard for typing with a button for uploading the result to an online gallery.

#### 3.3 The Setup

For our trial we deployed the photography service on a grid of large interactive displays in Oulu, Finland and let it operate for 6 months, from mid-May to mid-November in 2012, with no interruptions. The 12 displays used for the trial are 57” full-HD large form factor touch screen displays equipped with rich connectivity options (Figure 3). They are situated in pivotal urban locations, such as walking streets in downtown areas, a university campus, a popular swimming hall, and the main library. It should of course be noted that the locations of the displays were not chosen specifically for this application. They are available to citizens and tourists alike in a 24/7 fashion, and had already been deployed for years. As such, they have become an accepted part of the public city infrastructure itself. This is important because field trials often suffer from the novelty of the deployed technology.

It is also crucial to note that the displays were not dedicated to the photography service alone, but about 25 other services were simultaneously offered. The most popular services are typically games, such as adaptations of the traditional Hangman and Tetris games. Other applications at the time included news, service directories, public transport information, and commercial

advertisements. For more details on the displays, we refer the reader to [16].



**Figure 3. Examples of the public displays used in our field trial. The right-hand side of the screen is used by the active application.**

The photography application was accessible by a single click from a “main menu”, which opens when users are either sensed in the vicinity of the display or when a user touches the display.

### 3.4 Data Collection

We collected log data from all public displays about service launches and number of photo submissions. From the Facebook gallery we obtained data on visitors and their activities in the gallery. However, considering the qualitative nature of this work the most important data are the actual photographs that were collected during the trial and then analysed.

## 4. RESULTS AND ANALYSIS

### 4.1 Quantitative Data

During the 181-day field trial, the service was launched 1582 times (8.8 launches per day), resulting in 425 unique photos submitted to the online gallery of the service. To put this in context, the service was the 13th most popular service on the displays at the time (the total amount of all service launches on the displays was 42,936). Thus, 27% of the launches led to a photo submission. The daily service use and the amount of submitted photographs varied strongly between different hours of the day, with minimum amount of photos ( $N = 0$ ) taken between 05:00 - 07:00 and maximum ( $N = 45$ ) between 18:00 and 19:00.

The use of the public display service was not reflected in the online gallery. The gallery received only 33 unique online visitors during the study. Some of these are attributed to our own team, as we chose to also visit it to see what is happening. Thus, practically nobody visited it. Since the traffic of the online gallery was steadily low, so was the interaction with the photographs online. 23 photograph submissions out of the 425 were “liked” during the 181-day trial, and 16 comments were added to the photos online. The comments were without exception people joking around after recognizing themselves or their friends in the photograph or people leaving their own nickname or smileys as a comment.

### 4.2 Photograph Analysis

It became very soon apparent during the field study that practically none of the photos and their captions were related to the original purpose of the service, which aimed to elicit meaningful feedback for the city officials. This was naturally not completely surprising, as we expected some degree of appropriation because our study was conducted outside the safety of a laboratory setting [2,4]. However, in our case the appropriation radically exceeded both our and the officials’ expectations.

Unfortunately, this development also caused the city officials to lose interest in engaging with the users in the Facebook gallery. So, instead of collecting feedback for the city officials to interact with, we were collecting photographs of people expressing themselves in urban space with the help of the camera service. We had created a citywide installation of public camera devices for people to engage with. To turn this situation to our advantage, we decided to study the motivations behind the use and to learn more about the human conduct with a unique, public camera deployment. The user-contributed content, together with the embedded captions that can provide further clues about the human conduct with the service, provided a good starting point for observing emerging patterns.

After the six months long deployment time we performed thematic analysis of the photographs. For this purpose we organized a two-day workshop, in which three researchers with backgrounds in urban computing and sociology participated. Our procedure consisted of iteratively inspecting all of the photographs until we reached a consensus about the categories and could, in agreement, place any of the photos in one or more of the identified categories (practically: affinity diagrams.)

### 4.3 Overarching Themes

On day one of the workshop, we started by making an intuitive categorization of the body language in the photos to support discussion. Studying the photos, we agreed on four categories differentiated by easily observable postures and gesturing. This gave us an initial idea on how people physically act and behave with such camera services. The four overarching themes we identified were: posing, offending, calm and anonymous. These categories are illustrated with examples in Figure 1.

**Posing:** Posing and strong gestures to the camera were perhaps the most frequent behaviour. Users were captured lifting their hands up, twisting faces, grinning, and generally adopting playful poses mostly in groups.

**Calm:** Many of the analysed photographs contained people standing calmly in front of the cameras without any exceptional physical behaviour or movement – almost like as if not knowing what to do.

**Offending:** Besides posing, several users demonstrated offensive behaviour and gestures. Not surprisingly, this was often by showing the middle-finger(s) to the camera. This behaviour was more frequent in the photographs taken during the late hours of the day when the surroundings of the displays were free from bystanders and pedestrians. A few pictures with offensive gestures were taken in bright daylight and in the presence of bystanders.

**Anonymous:** We observed anonymous photographs. These are photographs with no persons in them: snapshots of just the background or random items, such as a pizza box, cap, or a hand blocking the camera view.

Posing and gesturing can be considered as archetypal acts in photography. However, it is interesting to observe the same behaviour with technology like ours as well. Users of public displays often feel strong social awkwardness and are wary of their surroundings, leading to discreet and moderate behaviour around the displays [1]. The many observed calm photos support this, but these users could have just skipped submitting the photo to the gallery. In other words, they still wanted to participate, wanted to have a dialogue in public. Posing was observed especially in groups, supporting findings that using services in groups is liberating and lowers the barriers of interacting freely with a public display [7].

A delightful exception to the calm behaviour of solo users was the numerous offensive photos that indicate users feeling liberated to use the displays: such strong gestures were captured even in bright daylight and with bystanders clearly present in the photos.

Finally, especially curious is the case of anonymous photos. Why capture snapshots of an empty view in front of the camera? These are not scenic photographs, as the cameras were immobile and the viewport area was just a public space fixed in front of the camera. Photography literature fails to document this kind of camera device use.

#### 4.4 Exploring Photograph Motives

The four initial categories helped us to understand the bodily user behaviour with the service, but they do not reveal much about the motives behind the snapshots. To mature our classification, to come up with a second layer of analysis that focuses more on traits outside body language, we looked into related research on photography with emphasis on sociology and psychology. On the second day of the workshop, we then reflected on the captions of the photographs as well. Ultimately, we evolved our second layer of classification to include eight categories that we feel best explain the actual motives behind capturing the snapshots.

**Self-presentation and expression:** One of the first clearly emerging motives we discovered was self-presentation and expression (Figure 4). These are common in traditional digital photography [23] and refer to an individual's needs for highlighting his/her activities, humour, or identifiable angles around oneself. This is one of the key reasons to post pictures on Facebook, where images are posted to subtly construct and highlight identities by “showing rather than telling” [24]. However, our gallery was anonymous and the photos were not published in users' personal feeds. Several photos were captured with captions that just stated the subjects' nicknames or names with very little extra details, such as “Claudio was here” or “it's me, Pekka”. Users wanted to construct their identity and bring themselves forward even without knowing who the audience was. These photographs represent the desire people feel for advertising themselves in their appropriation of new communication technologies [4].



Figure 4. Top row: self-presentation and expression - “marko”, “iino und claudio”. Bottom row: epigraphic photographs - “droit”, “YES, GO FINLAND!”

**Epigraphic:** Historically epigraphy is the science of identifying graphemes, clarifying their meanings, classifying their uses to

temporally relevant cultural contexts, and drawing conclusions about the authors. This transfers to the digital domain: we identify epigraphic photographs as being culturally, temporally or personally relevant to the photographer, the user – something (s)he wishes to bring up but that does not necessarily carry strong meaning to others. In the example we illustrate in Figure 4 a young man promotes his exclusive student club that is only famous locally. Another photo shows local kids supporting their favourite team in the ongoing ice hockey world championships. Basically, this is advertising, but not in the commercial meaning of the word, but promoting things close to one's heart and life.

**Performance:** The service was often used for documenting performances in public. We define performing as different from posing in the amount of effort needed to create the snapshot. Public display users are willing to use time and effort only if they see clear benefits in doing so [1]. The act of social performance in public was perceived satisfactory enough to engage with the display to capture stunning pictures together, such as the photograph of a group standing on their hands in Figure 5. Some researchers have even suggested that the public display itself is a stage [13,17]. This is visible in our results too, and especially groups performed and used the captions to advertise themselves.

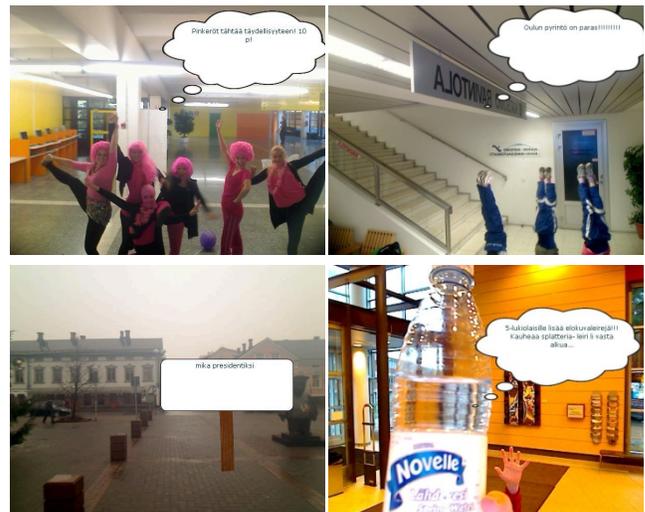


Figure 5. Top row: Performance - “Pinkeröt aims for perfection”, “Pyrintö is the best” (both are local dancing or gymnastics clubs). Bottom row: Anonymous yet expressive - “mika for president”, “more movie camps for fifth-graders!! horrible splatter – this camp was just the beginning...”

**Anonymous, yet expressive:** Many of the anonymous photos were found to have a clear purpose or an idea behind them after all. For example, one anonymous photo was playfully captioned “Wow! From the ghost of <name of the building>”, playfully implying that a ghost had taken the photo. Many other photos were captioned to express frustration, e.g. Oulu is a bad place”, but also positive signals were captured, such as Oulu rules!”. Users appropriated our service to express opinions about things around them without using the visual features.

**Framing:** An interesting occurrence was photographs accidentally or purposefully framing other passers-by. O'Hara discusses accidental interaction [14], where a member of the public accidentally wanders in front of a public screen with no intention of participating in the service. While in his work the accidental interactions provided other bystanders relevant cues on



So what happened when our system was deployed in the City and was left for use by citizens, freely and without coaching or supervision from researchers? It seems that the same design seemed to contribute towards a completely different end goal: appropriating the apparatus for personal play and engaging with the setup and other users. The high percentage of service launches that led to a photograph being submitted (27%) combined with the lack of interest towards the online gallery is a clear indicator of this.

Playful design combined with public displays has been previously argued as a successful combination for civic feedback services [6,7]. In this case we feel that it merely strengthened the predominant social context of public display users, who often use the displays as toys [13]. Key here is the unsupervised and “out there” nature of the trial presented in this paper: there were no researchers present to guide users or create pressure on taking the “right” action, which is often the case in field trials reported in academia [2].

Initially it was a conscious choice to allow users to view and share the photographs only online, in order to bridge the service users to the authorities in Facebook. Indeed, during the earlier trials the online gallery was popular, whereas in this study it was practically untouched. The concrete results, the photographs that were produced, simply did not interest users after the interaction with the camera was done. Now, if we however consider this from perspective of human behaviour in photography – as is the purpose of this research – all this starts to make sense and is in line with the ongoing evolution of photography. Currently, the value of a single snapshot itself is rapidly declining [18]. It has seen a heavy inflation. Traditional centric motivators of taking photographs, like later sharing or storing, do not appear behind the use of our medium, making our analysis highly topical to photography as a research field.

## 5.2 Learning from Human Behaviour

The categories identified earlier in our analysis suggest that public display cameras afford new kind of behaviours that have not been documented previously in photography or public display literature.

Let us first however look back in time. The camera has proven to be an important invention in capturing a special moment, a story or a memory, in our lives and passing it forward [15,18]. Following the digitization of photography the amount of captured moments has seen explosive growth, but at the same time the perceived value of the actual captured photograph has gone radically down. Increasingly it is the moment, the social process of taking a snapshot, that matters, not the result. This seems to be especially true with public camera installations like ours. We, as silent observers, can learn from these moments.

By allowing people to utilize public cameras for their own purposes, and at the same time capturing and analysing the photographs, it is possible to characterize the social affordances of a location: which spaces are more playful by nature, where do people allow themselves to ill-behave, or what kind of audience in general visits a given location? While this kind of recording medium, in fact, already exists in the form of ubiquitous security and surveillance cameras, people do not tend to react and use them for the social play and demonstration that we witnessed: they are simply too invisible. Public display cameras have the capability to leverage the visibility and appeal of the display itself. In addition, the lack of human photographer, who always has an impact on the subjects’ behaviour [21], yields users the freedom to act how they really wish with the technology itself. This makes

capturing the characteristics of the location highly effective with such apparatus.

It should also be noted that the online gallery introduced for this study obviously was a catalyst for some of the emerging behaviours. Advertising an ideology or protesting by ill-behaving in front of the cameras are good examples of what such cameras, hooked to public distribution media, can be expected to be used for. As public networked resources with capabilities to publish user generated content online (e.g. [12]) proliferate, it becomes important to understand what for and why will the general public actually appropriate the technology. How will the uncoached user make the technology relevant to the space where (s)he uses it? The in-depth photo analysis in this research aims to provide the first concrete clues on this.

The activities and behaviour that publicly available cameras capture can be leveraged when designing the future digital experiences for urban space and for similar technologies. The use of public cameras seems to be at least as rich as what has been documented earlier in related photography literature.

## 5.3 Onwards the Digital Path of Photography

Sarvas & Frohlich divide the evolution of photography in three paths: the Portrait Path, the Kodak Path and the Digital Path [18]. The portrait path was dominated by few photographers providing novel services to rich families and notable persons. Photographs, being often portrait-style snapshots, were cultivated and valued high. In the Kodak path, the camera became mundane and families could afford to have their own devices and start shooting their own photographs to store in printed albums. Finally, the currently ongoing digital path made the camera available to the masses in the form of cheap digital cameras and especially mobile phones, which today are carried even by the youngest of our family members. We have so far seen only a glimpse of what that the digital path will ultimately provide us.

Today it is no longer an economic necessity to appreciate photographs as earlier: they have become a basic commodity. For long now the trend has been that photographs are increasingly being used for constructing identities and for self-presentation online [23,24]. We find a lot of similarities between our findings and those from the Moment Machine studies [12]. These are platforms that earlier photography literature does not extensively document. The users of our service do not own or have control over the photographs, and they want to use the service for elaborate and socially coordinated snapshots, for documenting their daily life, play and behaviour in the space. It is used for supporting very natural human conduct in the public space, together with the other people in the space, and not for storing, sharing or showcasing the snapshots, all of which are traditionally reported as centric dimensions and drivers of photography.

We refer to such public photography services as digital mirrors. The name does not refer to the physical or material considerations of the apparatus, but to their negotiated purpose for the photographers. Digital mirrors are used for social and personal, even intimate, purposes in public: to mirror the social event at hands with no human photographer orchestrating and dominating the situation. While this alias is given fully in retrospect to our actual deployment, we feel it best describes our findings. Much of the photography literature builds on evaluating the past, on observing how and what for was a technology used.

We see our concept of digital mirrors as a conceptual milestone on the digital path of photography. It is not a shift away from personal cameras, but a technological complement to photography

by embedded, networked services in our environments. As such, it also honours the founding vision of Ubicomp. Our capabilities of leveraging the computing resources around us in our everyday lives for different uses is constantly growing and offering us richer communication opportunities.

## 6. CONCLUSIONS

Human conduct in public spaces is not guided by designers of the occupying technology but starts with the knowledge, motives and rationale of the user, the occupant of the space. We present a qualitative study of human behaviour in public urban spaces by analysing the use of an urban photography service.

Our findings of appropriation and behaviour with the deployed service enrich findings in existing photography literature, and we propose the concept of digital mirrors as an extension to the evolving digital path of photography.

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